Assessing groundwater availability of the Williston and Powder River structural basins, Northern Great Plains

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Groundwater availability in the lower Tertiary, Upper Cretaceous, and glacial aquifer systems in the Williston and Powder River structural basins is currently being assessed by the U.S. Geological Survey (USGS). The Williston structural basin is located in parts of North Dakota, South Dakota, and Montana in the United States and Manitoba and Saskatchewan in Canada. The Powder River structural basin is located in parts of Montana and Wyoming. A large amount of water is needed for energy development in these basins, and the primary accessible aquifers are glacial sand and gravel aquifers and the lower Tertiary and Upper Cretaceous aquifer systems. These aquifers commonly are the shallowest, most accessible, and in some cases, provide the only potable groundwater within the Northern Great Plains aquifer system. The USGS currently is conducting a 4-year groundwater availability study of these regional aquifer systems, which will include conceptual and numerical models of groundwater flow. Both of these models include a quantification of recharge and discharge components. In addition, the numerical model will be used to assess groundwater sensitivity to water withdrawals and climatic effects.

The components of groundwater recharge consist of recharge from direct precipitation on aquifer outcrops, infiltrating streams, and excess irrigation water; components of groundwater discharge to the land surface consist of discharge to streams and well withdrawals. Recharge from direct precipitation was estimated by using a soil-water balance model, with additional estimates from the water-table fluctuation and chloride mass-balance methods. The interaction between groundwater and surface water was quantified by analyzing streamflow records, using hydrograph separation methods, and implementing a water-budget analysis for major reservoirs in the study area. Groundwater withdrawals were quantified by analyzing Federal and State well databases and assessing previously published information. Estimated stream recharge accounts for 74% of total recharge, and direct precipitation and excess irrigation account for 23% and 3% of recharge, respectively. Discharge from groundwater is dominated by discharge to streams (96%) and well withdrawals (4%).